With currently available technology, such channel capacity is available only if the Commission awards no more than two MLDS licenses per market, with each licensee receiving 1000 MHz of spectrum.[46/] While such capacity is virtually unheard of in lower frequency bands, 1000 MHz in the 28 GHz band represents only 3.5 percent of the available spectrum; in contrast, television and MMDS utilize 62 percent and 7.4 percent respectively of the available spectrum. Moreover, such capacity is necessary for MLDS to be cable's technical equal.

It is conceivable that, someday, Quanternary Phase Shift Keying ("QPSK") or other spectrally efficient technologies will evolve to permit additional channel capacity and greater service. This technology upgrade will be equally applicable to cable, fiber

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as 16 competitors per city. Amendment of Parts 2, 21, 87, and 90 of the Commission's Rules to Allocate Spectrum for, and to Establish Other Rules and Policies Pertaining to, the Use of Radio in Digital Termination Systems for the Provision of Digital Communications Services, Report and Order, 86 FCC 2d 360 (1981). DEMS was a common carrier digital telecommunications network that could provide high-speed, end-to-end, two way transmissions of digitally encoded information. As a consequence of having insufficient spectrum to compete with the telephone company, DEMS never developed into a viable service.

Similarly, in creating MMDS, the Commission prohibited a single entity from licensing all eight MMDS channels in a city. Although, in recent years, the Commission has attempted to provide MMDS with additional channel capacity, MMDS has not evolved to its potential because of these bandwidth limitations.

46/ See Proposed Rule Section 21.1001, Appendix A. Given that the 28 GHz band contains 2000 MHz of spectrum and assuming each MLDS channel has a bandwidth of 18 MHz each, in order to provide each licensee with at least 48 video channels, there can only be two licensees.

and MLDS without the need for additional spectrum.[47] Two licensees should be sufficient to ensure a competitive environment. The introduction of two MLDS licensees to each market will inject two new entrants, each of whom will not only compete with each other, but with the entrenched monopoly cable provider. As a consequence, the FCC will ensure that the public has a choice of at least three providers for multichannel video service; such competition will permit market forces, rather than regulation, to ensure low prices and sector-specific program diversity.

C. Common Carrier Regulations Should Not Apply To MLDS Licensees

The Commission should decline to impose common carrier regulatory status on MLDS licensees.[48] Pursuant to the NARUC decision,[49] such non-common carrier status is appropriate here because there is no inherent legal compulsion that MLDS licensees hold themselves out to serve the public indiscriminately.[50]

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[47] Since both the wireless and wired systems begin with the same basic service parameters, any expansion of service by improvements in technology is equally applicable to both systems. This should speed the implementation of technology for improvement in quantity and quality of service as well as lower cost. New innovative services can utilize either system.

[48] See Proposed Rule Section 21.100, Appendix A.

[49] See NARUC v. FCC, 525 F.2d 630, (D.C. Cir. 1976), cert. denied, 425 U.S. 992 (1976) ("NARUC").

[50] See id. at 640-43. It is fully expected that MLDS licensees will "make individualized decisions, in particular cases, where and on what terms to deal." Id. at 641. As such, they cannot be considered to be common carriers. See id.

Moreover, as the Commission determined when it conferred non-common carrier status on Hye Crest: (1) MLDS would be only one of several video services available to consumers in any particular market; (2) MLDS licensees would not hold themselves out as serving all customers indiscriminately; and, (3) there would be no public interest need for MLDS licensees to comply with the obligations attendant to common carrier operation.[51] Non-common carrier status for MLDS is also beneficial because it will enable licensees to use some or all of their transmission time and transmission capacity for their own purposes, including controlling the content of their services, if they so desire. This ability will encourage the development of localized programming.[52]

D. A Channelization Plan Should Not Be Adopted for MLDS

Rather than adopting a specific channelization plan, the Commission should award each MLDS licensee a block of spectrum and allow the licensee to subchannelize it in any manner that satisfies the licensee's marketing, technical, and engineering needs with a minimum of 48 video channels.[53] The resulting

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[52] See Hye Crest Order, 6 FCC Rcd at 335, ¶ 26. See also Revisions to Part 21 of the Commission's Rules Regarding Multipoint Distribution Services, Report and Order, 2 FCC Rcd 4251 (1987).

[52] See Section IV supra.

[53] See Proposed Rule Section 21.1001, Appendix A. The Commission's decision regarding channelization in the satellite area is precedent for this type of approach. See Amendment of Parts 2 and 22 of the Commission's Rules Relative to Cellular

(footnote continued)

flexibility will allow MLDS to evolve in a market-oriented and innovative fashion.

E. MLDS Frequencies Should Be Granted On A Designated Service Area Basis Confined To A Primary Metropolitan Statistical Area

Suite 12 proposes that the Commission adopt a designated service area approach to provide each MLDS licensee with the freedom to select multiple transmitter sites within the boundaries of a Primary Metropolitan Statistical Area ("PMSA").[54/] As the Commission has previously stated, "[i]n view of the [short] propagation characteristics of the 28 GHz band, only a designated service area licensing scheme will provide the licensee with the necessary flexibility to select and timely establish antenna locations to facilitate efficient frequency re-use, and, thereby assure continuous signal coverage."[55/]

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Communications Systems, Report and Order, 61 RR 2nd 165 (1986), recon. den., 62 RR 2nd 1329 (1987), recon. den., 66 RR 2nd 1351 (1989), aff'd sub nom. Aeronautical Radio Inc. v. FCC, 68 RR 2nd 1387 (1991); Amendments of Parts 2, 22, and 25 of the Commission's Rules to Allocate Spectrum for, and to Establish Other Rules and Policies Pertaining to the Use of Radio Frequencies in a Land Mobile Satellite Service for the Provision of Various Common Carrier Services, Second Report and Order (to consider twelve Mobile Satellite Applications), 62 RR 2nd 48 (1986), clarified, 62 RR 2nd (1987), recon. den., 66 RR 2nd 1365 (1989).

54/ See 47 CFR § 21.500 and Proposed Rule Section 21.1002, Appendix A.

55/ Hye Crest Order, 6 FCC Rcd at 335, ¶ 27. This designated service area licensing scheme is also consistent with that allowed for DEMS and the Cellular Radio Telecommunications Service. See Revision of Part 21 of the Commission's Rules, Report and Order, 2 FCC Rcd. 5713 (1987), recon. granted in part, (footnote continued)

Without a designated service area approach, MLDS licensees will not be able to compete with other multichannel video distribution providers that serve entire metropolitan areas. Disjointed coverage, gaps in available channel capacity, and/or impaired signal strength would unnecessarily diminish the marketability of this new competitive service and severely impede its ability to compete against the entrenched and predominant presence of cable television in the market.

F. The Commission Should Award Blanket MLDS Licenses

Rather than requiring a MLDS licensee to seek a separate license for each cell site in the PMSA, the Commission should issue blanket licenses to cover the entire designated service area. In this fashion, the MLDS licensee will have the flexibility to engineer its system and locate its cell sites to take advantage of optimal millimeter wave propagation features. In addition, this process is administratively streamlined, it will conserve FCC resources, and it will permit prompt, efficient service delivery to the designated area.

In contrast, licensing the cells individually will result in a patchwork quilt of system design that would greatly diminish the feasibility of frequency reuse and operational compatibility. Moreover, each additional transmitter site would be subject to a

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65 RR 2nd 1849 (1989); An Inquiry into the Use of the Bands 825 - 845 MHz and 870 - 890 MHz for Cellular Communications Systems, Report and Order, 49 RR 2nd 809, 836, ¶ 87, appeal dismissed, Case No. 82-1526 (D.C. Cir. 1983).

full thirty day public notice period and thus to competing applications. Licensing each cell individually would serve no purpose but to introduce delay and unreasonably burden the Commission's administrative process; it would offer no countervailing benefits to the public.

To avoid these difficulties and to provide MLDS licensees with adequate flexibility to implement a consistent and efficient system design, Suite 12 proposes that the Commission apply the notification procedures described in 47 CFR Section 21.711 of its current rules for licensing each transmitter beyond the initial one.[56/] That rule section permits the licensee to notify the Commission's Engineer in Charge of the radio district of any new operation rather than seeking an individual license for each transmitter site within the PMSA.[57/]

56/ See Proposed Rule Section 21.1002, Appendix A.

57/ Alternatively, if the Commission is disposed to treat additional transmitter sites within the designated area as minor facility modifications, the approach of 47 CFR Section 21.41 may be appropriate. Under this approach, licensees for individual transmitter sites would be automatically granted on the twenty-first day following the date of the public notice.

G. The Commission Should Adopt Frequency Modulation As the Benchmark for Spectral Efficiency

While the Commission may choose to allow MLDS licensees to use other technical approaches, an FM network design, using 18 MHz per video channel, should be treated as a benchmark for spectral efficiency.[58/] MLDS applicants wishing to use some other technical approach (for example, QPSK or QAM) should be required to show that they can achieve at least the same capacity as an FM system based on at least 48 video channels at 18 MHz per channel, with the same frequencies being used at adjacent cell sites.[59/] Polarization reversal in both adjacent cells and shadow areas should be implemented to allow for non-interference performance, repeatability of signal, and maximum service capability. As is demonstrated in the attached Sarnoff Report, FM modulation is extremely spectrally efficient and should be utilized by MLDS licensees.

58/ See Proposed Rule Section 21.1006, Appendix A.

59/ It is unlikely that AM technology can achieve the same high level of spectral efficiency, because of the extreme power requirement, high intermodulation distortion, inability to reach shadow areas and inability to reuse the same frequencies in adjacent cells. See Sarnoff Report at 78-81.

VI. CONCLUSION

Suite 12 respectfully requests that the Commission initiate a rulemaking to reallocate the 28 GHz spectrum to MLDS and to license such systems pursuant to the rules proposed herein. Such a reallocation will be in the public interest because it will permit the establishment of competition to cable television and other services and it will permit currently fallow spectrum to be used.

Respectfully submitted,

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APPENDIX A

PROPOSED RULE

FOR

MULTICHANNEL LOCAL DISTRIBUTION SERVICE

APPENDIX A

Title 47
Code of Federal Regulations
Part 21

Subpart L -- Multichannel Local Distribution Service

Section 21.1000 Eligibility

Authorizations in this service will be granted in a non-common carrier basis. Applications will be granted only in cases where it can be shown that:

(a) The applicant is legally, financially, technically, and otherwise qualified to render the proposed service;

(b) There are frequencies available to enable the applicant to render at least 48 video channels; and

(c) The public interest, convenience and necessity would be served by a grant thereof.

Section 21.1001 Frequencies

Frequencies in the band 27.5-29.5 GHz are available for this service. Within each service area, the two frequency bands 27.5-28.5 GHz and 28.5-29.5 GHz are available for assignment to two different entities. Licensees should use the assigned frequencies both for the distribution of video programming to their customers and for interconnecting among their transmitter locations. There is no requirement that any specific channel plan be employed. Licensees may subdivide their assignments into channels of any bandwidth, providing that the minimum service capability requirement of Section 21.1007 is satisfied.

Section 21.1002 MLDS Service Area/Interference Coordination

An MLDS licensee is granted exclusive use of its assigned frequency band throughout a service area which consists of a Primary Metropolitan Statistical Area as defined by the U.S. Department of Commerce or other area specified in the license. The licensee may locate transmitters at any location within its assigned service area, provided that the licensee (1) satisfies the interference considerations of this Section by polarization diversity and (2), for transmitters constructed after the grant of the initial license, complies with the notification procedures of Section 21.711. The licensee is responsible for subdividing that frequency band in a manner that makes efficient use of the spectrum and minimizes interference within the service area. Adjacent cells should use opposite polarization in order to eliminate harmful interference.

At and near service area boundaries, MLDS licensees shall make exceptional efforts to avoid harmful interference to other licensees by continuation of the polarization change and frequency diversity technique. Licensees are expected to cooperate fully in attempting to resolve problems of potential interference before bringing the matter to the attention of the Commission.

Section 21.1003 Construction Period

The licensee shall complete construction and make service available to 75% of the designated service area within 5 years of the date of grant of a construction permit. In lieu of a Certificate of Completion of Construction, the licensee shall submit annual reports that describe the extent of service availability.

Section 21.1004 Power

Stations in this service shall not be authorized to use transmitters having a rated power output in excess of the limits set forth in Section 21.107(b), provided, however, that for transmitters carrying multiple video channels, the power limit shall be interpreted as the power per video channel.

Section 21.1005 Bandwidth and Emission Limitations

Stations operating in this service may employ any bandwidth, up to the full assignment of 1000 MHz. Stations must conform to the emission limitations of Section 21.106 only at the edges of the assigned frequency band.

Section 21.1006 Modulation/Minimum Service Capability

Stations in this service may employ any modulation. However, applicants as part of their application must supply a technical showing that their system design will make use of the spectrum in as efficient a manner as frequency-modulated video with a bandwidth of 18 MHz per video channel. As part of this showing, applicants must show that they will provide at least 48 channels of video with a 99.9% availability throughout their assigned service area.

Section 21.1007 Antennas

Stations used for distributing MLDS programming or other services to more than one site may employ multi- or omni-directional antennas. Stations used as fixed MLDS response stations or for the interconnection of transmitter locations shall employ directional antennas with a maximum beamwidth of 10 degrees.

Section 21.1008 Spectrum Utilization

As part of their application, applicants should submit their plan for reusing frequencies at multiple transmitter locations, and for interconnecting their transmitter sites using frequencies within their assigned band. Systems shall employ polarization diversity to permit the entire frequency assignment or any portion of it to be reused within a cell and adjacent cells for video distribution. Systems shall employ polarization diversity to discriminate between video distribution and other uses. In addition, applicants must provide the minimum service showing of Section 21.1006.

Section 21.1009 MLDS Response Stations

MLDS response stations may employ any frequency within the assigned band and any bandwidth necessary to carry authorized services. Response stations may be used for the carriage of any signals including voice, data or video signals. MLDS response stations may be fixed or mobile. Fixed response stations must employ directional antennas with a maximum beamwidth of 10 degrees.

Section 21.1010 Frequency Stability

Stations in this service shall comply with the frequency tolerance requirements of Section 21.101.

Section 21.1011 Permissible Use

MLDS licensees must use their assigned frequencies for the delivery of entertainment video programming to multiple locations. In addition, they may use their assigned frequencies for voice, data and other video uses, so long as at least 49 channels of entertainment video are provided throughout the service area.

Section 21.1012 MLDS Repeaters

Active and passive MLDS repeaters may be employed to provide adequate signal coverage to shadowed areas.

APPENDIX B

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17 September, 1991

SUITE 12 SYSTEM ANALYSIS FOR VIDEO DISTRIBUTION AND SECONDARY SERVICES

Prepared for
Suite 12
12 Dag Hammarskjold Boulevard
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Project Name: Brighton Beach
Task 2 Completion Report

Executive Summary

Many innovative advances in millimeter wave component technology have occurred in recent years. The technology has reached a point where it is now economically feasible to apply it to consumer and commercial oriented applications. Suite 12 has proposed a novel concept for a communication system which allows the distribution of a very high quality multi channel video signals and two-way audio, video, and data transmission throughout a localized area.

The system encourages the use of new developments in millimeter wave technology and makes use of a frequency band which has, up to now, been unoccupied. The system is capable of distributing 49 channels of video to the customers home. The video programs received by the subscribers are of studio quality and represent the highest attainable quality for any distribution system including fiber optic cables. Two-way transmission of audio, video, and high speed data are additional capabilities of the system which will enable the consumer to enjoy a diversity of communication options. The system is inherently capable of making full use of any future advances in broadcast and communication technology (e.g. high definition television and digital communications). Because the system makes use of electromagnetic radiation through the air, it does not impose the physical constraints associated with hard-wired systems such as coaxial and fiber optic cable. As a result, the cellular system can be supplied to areas which already have cable distribution, providing the customer with a competitive alternate source of service.

Suite 12's system as described in U.S. Patent 4,747,160 (issued to Bernard B. Bossard), is a multicell configured distribution system with a return path capability operating in the frequency range of 27.5 to 29.5 GHz. Within a cell, 1 GHz of this frequency range is used to transmit 49 video channels. The video

channels are transmitted with the same polarization. Each channel consists of a frequency modulated signal occupying a 20 MHz channel. Two-way communication channels are inserted between the video channels and are transmitted with the opposite polarity. The combination of frequency shift and polarization reversal provide 40 dB of isolation between the two different services. The transmitted signals from the center of the cell (the node) originate from an omni-directional antenna. The consumer receiver antennas (the subscriber) provide very narrow beamwidths which virtually eliminate multipath reception. The diameter of each cell is between 6 and 12 miles. Within each cell, shadow areas (areas which are not directly in the line of sight of the transmitting antenna due to some obstruction) can be covered with a repeater or reflector.

Signal coverage to a larger area can be implemented by using a multi-cell configuration. Transmitted signals in adjacent cells are cross-polarized. The narrow beamwidth subscriber antennas, which are physically small at this frequency (3 to 15 in.), along with the polarization reversal between adjacent cells, provide a very high degree of rejection to interference from adjacent cells. They also produce sufficient isolation from those very limited regions of diagonally opposite cells. Thus, unlike other point-to-multipoint systems, expansion of a single cell into the immediate adjacent cells can be accomplished without the need for additional frequency spectrum. Suite 12's novel combination of the properties of antenna polarization, frequency modulation, space diversity, and frequency diversity produce a system which is exceptionally efficient in its use of the frequency spectrum.

The purpose of this report is to review the Suite 12 system for technical feasibility and to make recommendations for its implementation. The following is a summary of the findings.

A video distribution system presently can be employed with the following characteristics.

TWTA Saturated Output Power:	100 Watts
TWTA Operating Backoff:	7 dB
Modulation Type:	FM
Number of Channels:	49
Channel Bandwidth:	18 MHz
Channel Spacing:	20 MHz
RF Bandwidth:	1000 MHz
Antenna Gain:	10 dB

Receiver Characteristics:

Antenna Size:	3 in. diameter (near transmitter) 15 in. diameter (cell fringe area)
Noise Figure:	6 dB

Performance Factors:

Cell Diameter:	7.8 miles (NY) 12.4 miles (LA)
SNR:	55 dB (clear weather) 42 dB (rain fade)
Rain Availability:	99.9%
Unavailability in fringe area:	8.76 hours/year

Minor modifications to DBS satellite receivers with an IF that is greater than 1 GHz in bandwidth (e.g., 950 to 2050 MHz) can be used for this system. If video scrambling and pay-per-view options are required, several vendors already provide these options. The FM receiver units also come with automatic frequency

control (AFC), the pull-in range of which is adequate to compensate for RF local oscillator frequency instabilities. The 26 GHz front end of the consumer receiver can be assembled with off-the-shelf equipment. An inexpensive version has been demonstrated by both Hye Crest and Sarnoff and is presently being readied for production quantities.

It is recommended that 20 MHz digital video carriers be introduced when the terrestrial HDTV standard is established and video decompression hardware begins to be available at reasonable costs. The digital carriers can also deliver up to 150 standard definition video channels to the consumers. The Suite 12 system has the intrinsic bandwidth capacity to effectively compete with in-place cable systems. Any future improvements in compression technology can be equally supported by both systems. Service providers can immediately implement innovative technology and services using the Suite 12 system as a transmission platform.

Rain depolarization, fade margins, and multipath are not a problem for short range millimeter wave propagation and reception by antennas that have narrow beamwidths.

In the fringe areas, the quality of the picture (99.9% of time) is not degraded by the distribution system because the carrier to noise ratio of the system is 55 dB. This is considered to be studio quality and substantially exceeds the quality of cable and fiber optic systems.

Two-way communication links between the head end and subscribers can be economically established using low power solid-state transmitters, e.g., 5 to 10 mW transmitter power at the subscriber antenna input for a 200 KHz bandwidth channel, 100 mW will support DS-1, and powers of 1 W will support DS-3 service. These links can be used for analog or digital telephones, computer data and digital video services. By using hardware from emerging or established

standards, e.g., analog and digital cellular radio systems, it is possible to economically develop the communication network in a phased manner. By relying on these standards the necessity to develop custom hardware is substantially reduced at all parts of the network, except RF transmission subsystems. All aspects of the Suite 12 cellular system have been demonstrated at Sarnoff, and developmental work for inexpensive hardware is in progress.

The Hye Crest/Suite 12 system is very bandwidth efficient in its innovative use of polarizations, frequency diversity (interleaving), spacial diversity, and narrow beamwidth small size receiving antennas. It has all the attributes of a hardwired cable or fiber optic distribution system including the ability to take advantage of emerging video compression technologies. The system is both technically and economically feasible.

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Section I

SYSTEM PERFORMANCE PARAMETERS

1. Introduction

The purpose of this report is to technically review the Suite 12 millimeter wave multi-channel distribution system and suggest methods for optimizing the use of the 27.5 to 29.5 GHz frequency spectrum in its application to video distribution and two-way interactive services (i.e., telephone, video phone, and data).

The first section of the report analyzes the transmission and propagation characteristics of 28 GHz communication systems and the various modulation methods which can be used to provide the best attainable system performance with realizable and cost effective components.

The second section describes the Suite 12 system, along with details on the frequency plan, transmitter and receiver components based upon the technical analysis of the first section.

2. Link Equations for Determining Effective Radiated Power (ERP)

A basic communication system consists of a transmitter and receiver. The most important criteria in establishing the viability of a communication system is to establish the necessary relationships between the transmitter power, receiver noise figure, distance between transmitter and receiving sites, and other factors effecting the path loss between transmitter and receiver.

The following notations will be used.

ERP/carrier = Effective radiated power (dBW), per video carrier

ERP(total) = Total ERP required from the transmitting system for n video carriers, dBW

n = Number of video carriers